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***Pellaea atropurpurea* (L.) Link and *Pellaea glabella* Mett. ex Kuhn.**

FREDERIC K. BUTTERS

At the time that Prof. F. L. Pickett's recent article entitled "Is *Pellaea glabella* Mett. a distinct Species?" appeared in the AMERICAN FERN JOURNAL, I had recently examined all of the specimens of *Pellaea atropurpurea* and its allies in the Gray Herbarium and the Herbarium of the New England Botanical Club in an attempt to settle the identity of some ferns of this group from western Canada, and it may be of interest to record some of the facts which were disclosed by this study.

Of the fern genera represented in the eastern United States, *Pellaea* and the closely related genus *Cheilanthes* are peculiar in reaching our area from the south by way of South America, Mexico, and the southwestern part of the United States. *Pellaea* is a typical austral genus, highly developed in temperate and tropical south Africa, the Malayan region, Australia, the Pacific Islands, and the Andes of South America, while it is entirely wanting from Europe, the Mediterranean part of Africa, and from Asia north of the Himalayas. Moreover, unlike many genera and even species of Andean ferns, it is nearly absent from the West Indies.¹ In Mexico there are about twenty species of this genus, and in our southwestern states over a dozen, while in the eastern portion of North America there are only the species here discussed and *Pellaea densa*, which occurs from California to British Columbia and western Montana,

¹ The only species which is known to occur in the West Indies is the widely distributed *P. ternifolia*, which was found by Baron Eggers in the mountains of Santo Domingo at an altitude of over 7500 ft., in a region whose flora shows much closer relationships to continental America than to other parts of the West Indies. See Urban, Ign., Zur Hochbirgs Flora von Sto. Domingo. Symbolae Antillanae 6: 286 et seq. 1909.

and then jumps to the Gaspé Peninsula of Quebec with a single intermediate station in Grey Co., Ontario, in the vicinity of Georgian Bay.

Pellaea atropurpurea itself is reported from the Andes, though I have seen no South American material of this species. It occurs more or less throughout Mexico as is indicated by specimens from Chiapas in the extreme south, from the region of Orizaba in the east and from Sonora in the northwest. In the United States it occurs in Arizona (Conservatory Canyon, Huachuca Mts.) and extends thence eastward to the Atlantic, as is testified by abundant material from nearly all the southern states in which there are rock outcrops suitable for its growth. With a single exception, the most northerly stations represented by specimens in the Gray Herbarium are eastern Kansas, central Missouri, southern Illinois and Indiana, central and eastern Pennsylvania, western New York, northern New Jersey, and western New England.

In New York there are several specimens from the vicinity of Syracuse, one from Seneca Lake and one from Fowler in St. Lawrence Co. In New England it is abundant in western Connecticut and southwestern Massachusetts, and occurs at North Pownal, Dorset, and Burlington, Vermont. There are specimens from only two stations east of the Connecticut River, Mt. Toby, Sunderland, Massachusetts, and Lime Rock, Lincoln, Rhode Island, though I have definite information of a third locality in Bolton, Connecticut.

References to *Pellaea* in the southern counties of Ohio are probably based at least in part on this species, though I have seen no specimens of it from that state, and Prof. Pickett's station in southeastern Nebraska extends the range slightly to the northwest of the limits just outlined. The single exception noted above is that true *Pellaea atropurpurea* occurs in the southern

part of the Black Hills of South Dakota, from which locality there are specimens in the Gray Herbarium.²

Pellaea glabella, on the other hand, has a decidedly northern range. It is apparently more abundant and widespread in Vermont than *P. atropurpurea*. In addition to specimens which show that *P. glabella* occurs with *P. atropurpurea* near Burlington and at North Pownal, there is material of the former from Pittsford and from Willoughby Mt., Westmore. There are no specimens from southern New England in either the Gray Herbarium or that of the New England Botanical Club. There is a single specimen from York Co., Pennsylvania, one from Erie Co., Ohio, one from Owen Sound, Ontario, three from Wisconsin, two from southeastern Minnesota, one from Clinton, Iowa, seven from Missouri, chiefly from the northern half of the state, and two from eastern Kansas—both of the last mentioned being mixed collections of the two species. There are no specimens of *Pellaea glabella* from any of the southern states.

It seems probable that all references to *Pellaea atropurpurea* in Canada³ (with the possible exception of southern Ontario), where it is reported to occur as far north as Great Bear Lake, on the Arctic Circle, refer either to *P. glabella*, or to one of its western varieties.

In Minnesota and western Wisconsin, where I am personally familiar with this fern in its living state, it occurs pretty widely distributed on cliffs and ledges of dolomitic limestone or rarely on calcareous sandstone

² These specimens are: Hot Springs, 3500 ft. altitude, July 14, 1892, P. A. Rydberg no. 1190; False Bottom Gulch, 4000 ft. altitude, Aug. 10, 1909, John Murdoch, Jr. no. 3573; "Black Hills Region, Aug., 1891, Williams." The occurrence of this fern in the Black Hills, so far to the northwest of its normal range, and at comparatively high altitudes, seems to be entirely parallel to the occurrence of another southern fern, *Adiantum Capillus-Veneris*, in the same region. See C. E. Bessey, Bot. Gaz. 26: 211, and Science, New Series, 8: 587.

³ Such as Hooker, W. J., Flora Boreali-Americana, 2: 264, 1940. Macoun, John, Catalogue of Canadian Plants, 5: 260, 1890.

lying immediately below such ledges. It prefers full exposure to the sunlight, and sends its roots back deep into the joints of the rock. On prying off a piece of the ledge, I have exposed a mass of fern roots which extended back nearly a meter into the crack. It is undoubtedly this habit of deep rooting which enables the plant to live on dry and sun-baked ledges. In winter it can get almost no protection from the snow, but I have never seen it injured by the very low temperatures (-35°C and even -40°C) which are not infrequent. I have never seen *P. atropurpurea* in Minnesota or western Wisconsin. All of the cliff-brakes there are uniformly of the other species and they uniformly show the blue-green color mentioned by Pickett in his first article on these ferns.⁴

It is thus seen that *Pellaea atropurpurea* and *P. glabella* occupy almost entirely distinct ranges, which barely overlap along a line running from Vermont to Kansas. Each species is remarkably uniform throughout a very extended range and the differences between them, so well brought out by Pickett, are equally well marked whether specimens are compared which come from the extreme limits of their range, or are taken from plants growing together on the same cliff, and collected at the same time. In view of these facts, there can be, I think, no question that they are perfectly distinct species.

In regard to the differences between them, I may cite a few points not noted by Pickett in his article, and one point in which my observations are not fully in accord with his. The scales of both species are composed, except at the very base, of elongated cells, those of *P. atropurpurea* being 10–20 times as long as they are wide, those of *P. glabella* about six times as long as they are wide. The scales of *P. atropurpurea* are entire

⁴ Amer. Fern Jour. 4: 97. 1914.

or very obscurely toothed, the teeth being visible only under a microscope of fairly high power. The scales of *P. glabella* usually have, on each side, a few rather prominent blunt teeth, easily seen with a good handlens.

The spore measurements given by Pickett appear to be considerably too large, at least as applied to herbarium material. My measurements are as follows: spores of *P. atropurpurea*, $50-68\mu \times 45-55\mu$; spores of *P. glabella*, $55-85\mu \times 45-60\mu$. Whether this discrepancy is due to the shrinking of the spores in herbarium material, or to an error in scale, can be determined only by examining fresh spores which are not available at the present writing. I find that, on the whole, the shape of the spores does not differ materially in the two species. Both have some spores which are plainly tetrahedral, some obscurely tetrahedral, some nearly spherical and some elliptical. In both species the spores have a wrinkled episore, that of *P. atropurpurea* being much more coarsely wrinkled than that of *P. glabella*. In both species, in mounts of spores from herbarium material, the episore is apt to crack off exposing the nearly smooth, pale yellow spore.

In conclusion, it is well to note that there can be no possible doubt as to the proper application of the two specific names. In both cases the original descriptions are truly diagnostic. In addition, it is to be noted that *Pteris atropurpurea* of Linnaeus was founded on one of Clayton's plants described by Gronovius and cited as growing "ad ripam fluminis Rappahannock in umbroso loco ad Juniperi radicem juxta promontorium Anglice Point-look-out dictum,"⁵ a region where *P. glabella* is unknown. On the other hand, the habitat originally cited for *P. glabella* is "Kimmswick prope St. Louis. Visconsin. Columbia anglica (Lyll). Rocky Mts.,"⁶ a

⁵ Gronovius, J. F., *Flora Virginica* 197. 1739.

⁶ Kuhn, Max, *Reliquiae Mettenianae*. *Linnaea* 36: 87. 1869.

range which corresponds entirely with the distribution of *P. glabella* as here recognized, taken together with a western variety of that species, while *P. atropurpurea* is not known in either Wisconsin or British Columbia.

Typical *Pellaea glabella* appears not to cross the plains, but in the Black Hills, northern Rocky Mountains and westward, there are two forms which are so closely related to this species that it seems best to consider them as varieties of it.

One of these is *P. glabella* var. *occidentalis* (E. Nelson),⁷ a plant which has already given a good deal of trouble to western systematists and collectors, having been variously cited as *P. Breweri*, *P. atropurpurea*, as a new variety of the last mentioned species, and as a new species. That it is much more closely related to *P. glabella* than to *P. atropurpurea* is shown by the glabrous stipes, the form and structure of the scales, and the shape of the leaflets. In fact, in both of the last mentioned characters, it stands at one extreme of a series, and *P. atropurpurea* at the opposite extreme.

It differs from typical *P. glabella* in its smaller size, in having simpler and somewhat less coriaceous fronds with broader and less revolute fertile pinnae, in having shorter cells in the scales, and in having somewhat smaller spores, which are of a more uniformly tetrahedral shape. In size it varies from a height of about 2 cm. in the case of very depauperate individuals, to a maximum height of about 15 cm., apparently rarely exceeding 1 dm., while mature plants of typical *P. glabella* are rarely under 1 dm. high.

The fronds of the variety are almost always simply pinnate, though the lowest pinnae are rarely ternately

⁷ PELLAEA GLABELLA Mett. ex Kuhn, var. **occidentalis** (E. Nelson) new comb.

Pellaea atropurpurea occidentalis E. Nelson, Fern Bull. 7: 30. 1889.

Pellaea pumila Rydb. Mem. New York Bot. Garden, 1: 4. 1900.

Pellaea occidentalis (E. Nelson) Rydb. loc. cit., 466. 1900.

cleft into nearly equal segments, or, still more rarely, ternately compound. In the typical form of the species the lower one or two pairs of pinnae are nearly always ternately compound, even in depauperate individuals. The fertile pinnae of the variety are ovate or elliptical, and conspicuously broader than the ovate-lanceolate fertile pinnules of the common form. They also have less revolute margins, and are of a somewhat thinner texture. In all these respects, however, eastern specimens of this species display considerable variation, and occasionally approach very close to the western variety. Thus a specimen in the Gray Herbarium from Margaretta, Erie Co., Ohio, collected August 22, 1895, by E. L. Moseley, has some fronds which are almost exactly like those ordinarily seen in the variety *occidentalis*, though the spores and the scales are those of the typical eastern form.

In *Pellaea glabella* var. *occidentalis* the cells of the scales are oblong, and even shorter than in the typical form of this species, being only 3-5 times as long as they are wide. The spores of the var. *occidentalis* differ from those of the typical form in being uniformly tetrahedral, 45-55 μ in diameter.

In view of the inconstancy of some of these points of difference, and the very minute character of the others, it seems best to the author to regard this form as a geographical variety of *Pellaea glabella*. All specimens of it in the Gray Herbarium are from South Dakota and Wyoming, though it probably has a somewhat more extended range. It is to be noted, however, that many plants which have been distributed or cited under the names *P. pumila* Rydb., and *P. occidentalis* (E. Nelson) Rydb., have been incorrectly identified, and belong either to the following variety, or to *P. Breweri*.

The following is a list of the specimens of *P. glabella* var. *occidentalis* in the Gray Herbarium:

SOUTH DAKOTA: Bull Springs in the limestone district west of Custer, altitude 6000–6500 ft., July 27, 1892, *P. A. Rydberg* no. 1191 (the type collection of Rydberg's *P. pumila*, plants about 4 cm. high, lower pinnae sometimes compound).

WYOMING: on a perpendicular wall of limestone in a canyon, Laramie Hills, Albany Co., May 14, 1899, *A. & E. Nelson*, no. 6837 (this appears to be from the type locality of Nelson's *P. atropurpurea occidentalis*, though it is not the type collection; it is an exceedingly depauperate form scarcely 3 cm. tall, and corresponds entirely with the original description of Nelson's variety); on limestone rock, Tongue River Canyon, 5000 ft. altitude, September 5, 1900, *J. G. Jack* (one small plant very similar to those of the Rydberg collection, and two others, much better developed, 10–15 cm. tall).

The second western variety of *P. glabella* appears to be hitherto undescribed. It is

PELLAEA GLABELLA Mett. ex Kuhn, var. **simplex** var. nov., *pumila*, frondibus 1–8 cm. longis pinnatis, pinnis 5–13 simplicibus sessilibus vel brevissime petiolatis lanceolatis vel ovato-lanceolatis 5–18 mm. longis 1.5–5 mm. latis fertilibus forte revolutis; paleis rufis 0.25 mm. latis cellulis elongatis instructis; stipite basin versus paleis capillis longis instar infrequentibus pubescente.

Like the typical form of the species in its strongly coriaceous and revolute narrow leaflets, this variety differs in its very small size and apparently in having the pinnae always simple. Its scales are somewhat narrower than those of typical *P. glabella*, rather long caudate, about 0.25 mm. wide at the base, and composed of cells 10–15 times as long as they are wide. The bases of the stipes are sparsely pubescent, with long hair-like scales. The spores are nearly as in the typical form, elliptical, and 56–77 μ long.

In the Gray Herbarium there are three specimens of this variety:

NEW MEXICO: Ft. Wingate 1883, *W. Matthews*.

WASHINGTON: Klickitat Co., August 11, 1892, *W. N. Suksdorf* no. 2083.

BRITISH COLUMBIA: dry face of cliff, Carbonate Draw (upper Columbia River above Golden) altitude 5900 ft. July 14, 1904, *E. R. Heacock* in *C. H. Shaw's* Selkirk Flora no. 272 (type).

It seems highly probable that all reports of *Pellaea glabella* and of *P. atropurpurea* from western Canada are based upon the variety just discussed. Thus in the original description of *P. glabella*, the range is given, "Kimmswick prope St. Louis, Visconsin. Columbia anglica (Lyall). Rocky Mountains,"⁸ and Macoun, who does not distinguish between *P. glabella* and *P. atropurpurea*, cites the following western stations for the latter species: "rare in crevices of limestone rocks on mountains near Kananaskis Station, Rocky Mountains, on the C. P. Ry., and on limestone cliffs, Clearwater River, north of Methy Portage, Lat. 57° N. W. Ter.; canyon near Buffalo Road Bridge and Cache Creek, B. C. (Macoun.) Hillsides on broken rocks, not common, Kootanie District, B. C. (Anderson.) Canada to Bear Lake and the Rocky Mountains. (Richardson, Drummond.) Mountains between Nicola and Kamloops, B. C. (Lawson.) Banff, Rocky Mountains Park. (J. Smith.)"⁹

It is to be noted that the two western varieties of *P. glabella*, like the typical eastern form of this species, appear to be strictly calciphile. Limestone is mentioned as the habitat in all cases where any rock is specified, and in other cases the region mentioned is known to consist of limestones. The type specimen of the var. *simplex* comes from a region of calcareous foothills which is known to have a strongly calciphile flora.

⁸ Kuhn, Max., *Reliquiae Mettenianae*, Linnaea **36**: 87. 1869.

⁹ Macoun, John, *Catalogue of Canadian Plants*, part 5: 261. 1890.

Note on the range of *Pellaea Breweri* D. C. Eaton:

As there has been much confusion in the distinction of this species and *P. glabella* var. *occidentalis*, and as numerous specimens of *P. Breweri* have been distributed under the name *P. occidentalis*, it seems well to note briefly the characters of *P. Breweri* and what is known about its range.

This fern was originally described by D. C. Eaton from specimens from the Sierra Nevada Mountains of California.¹⁰ It is clearly characterized by its extraordinarily brittle stipes and non-coriaceous fronds, and by the peculiar form of its pinnae, which are usually mitten-shaped, or two-lobed, with the anterior lobe considerably larger than the posterior. It is well illustrated in Eaton's *Ferns of North America* 1: pl. 43.

The range of *P. Breweri* is from the Sierra Nevada Mountains, through the basin ranges of Nevada and Utah, to the Blue Mountains of Oregon, central Idaho, and western Wyoming. Throughout its range it is remarkably uniform in character. Unlike the varieties of *P. glabella* it seems to grow by preference on granitic rocks.

There are a large number of specimens of this fern in the Gray Herbarium. It seems unnecessary to cite those from California and Nevada, as there has been no confusion concerning it in those states. The following are the specimens from the northern and eastern portions of its range:

WYOMING: crevices in rocks, Leucite Hills, June 17, 1901, *E. D. Merrill* and *E. N. Wilcox* no. 474; same locality, June 18, 1901, *Merrill* and *Wilcox* no. 513.

IDAHO: rock crevices along the stream, Bear Canyon, Mackay, Custer Co., July 31, 1911, *A. Nelson* and *J. F. Macbride* no. 1442.

¹⁰ Eaton, D. C., *Proc. of the Am. Acad. A. & S.* 6: 555. 1865, is a communication by Dr. Asa Gray on Characters of some New Plants of California and Nevada.

UTAH: rock crevices, Provo, June 16, 1902, *L. N. Gooding* no. 1114; Big Cottonwood Canyon, Lake Solitude, June 30, 1905, *Rydberg* and *Carlton* no. 6529; Cottonwood Canyon, Salt Lake Co., August 14, 1905, *A. O. Garrett* no. 1610; City Creek Canyon, July 11, 1885, *F. E. Leonard*; Peterson Canyon, Wahsatch Mts., 10,000 ft. altitude, July 19, 1902, *Pammel and Blackwood* no. 3844; Alta, Wahsatch Mts., 9000 ft. altitude, July 31, 1879, *Marcus E. Jones*, no. 1118; Cottonwood Canyon, 9000 ft. altitude, July, 1869, *Sereno Watson*.

OREGON: Union Co., 1877, *N. C. Cusick*.

CAMBRIDGE, MASS.

The Male Fern in Vermont

E. J. WINSLOW

On the 19th of last July, in company with Prof. E. A. Shaw, of Norwich University, I discovered an extensive growth of Male Fern on Paine Mt. in the town of Northfield, Vt. About two weeks later, on August 6th, I returned to Northfield with Mr. C. H. Bissell and we then made a more complete survey of this station.

Paine Mt. is a level ridge 2600 ft. in elevation, extending in a north and south direction, covered at the summit with recent growth forest except a portion of the south end of the ridge and a clearing extending from this point down the western slope and rapidly widening out into extensive pastures. The rock is slatey and further down toward Northfield village are several abandoned slate quarries.

At this cleared south end among the rocks and bushes and scattered through the neighboring thickets the Male Fern is vigorous and abundant and from there it continues down the slope in a general northwesterly